(Please write your Exam Roll No.) Exam Roll No. 01723603415

END TERM EXAMINATION

SIXTH SEMESTER [B.TECH] MAY-JUNE 2018

Paper Code: ETCE-308	Subject: Open Channel, Flow And Numerical Hydraulics

[Batch-2013 Onward]

Time: 3 Hours Maximum Marks: 75

Note: Attempt five questions in all including Q. no.1 which is compulsory. Select one question from each unit. Assume suitable missing data if any.

Q1 Attempt **any five** questions:

(a) Starting with the expression of shear stress in rigid-boundary channels, derive Chezy's equation and derive the relation between the Chezy's and the Manning's coefficients in open channel flow. **(5)**

(b) Define gradually varied flow and rapidly varied flow giving examples. Designate using conventional symbols the types of channel slopes as used for describing profile of open channel flows. **(5)**

(c) Define sequent depths. Starting with assumptions, derive an expression for calculating the sequent depth for a hydraulic jump in a rectangular channel. **(5)**

(d) What are the modes of sediment movement in a mobile boundary channel? Define critical velocity ratio. **(5)**

(e) Write down the steps in designing a mobile-boundary channel using Kennedy's theory if the design discharge, the rugosity coefficient, the bed slope and critical velocity ratio are known. **(5)**

(f) What are the principle hydrodynamic processes that determine the fate of pollutants in a stream? Explain with sketches. **(5)**

(g) What are the advantages of the finite volume method for solving diffusion problems over finite difference method in numerical hydraulics? **(5)**

UNIT-I

Q2 (a) Starting with the energy equation, derive an expression of critical depth at a section in a channel. Show that, for a rectangular channel, the velocity head under critical condition is half the depth of flow. **(6)**

(b) Define subcritical and supercritical flow giving examples. Show the regions of these two types of flow on a specific energy curve. **(2.5)**

(c) Water flows at a depth of 2.0 m and a velocity of $1.5\,ms^{-1}$ in a 4.0 m wide channel. Find the width at a contraction that just cause critical flow without change in the upstream depth. **(4)**

Q3 (a) What is 'conveyance' of a channel. What is the unit of manning's roughness coefficient? What are the factors on which this coefficient depends? **(2+2+2=6)**

(b) A trapezoidal channel carrying a discharge of $25\,m^3s^{-1}$ with a bed slope of 1 in 1500 has side slopes 1:1 at the most efficient section. Design the section if manning's coefficient is 0.0135. **(3)**

(c) For a constant specific energy of 1.8 kg-metre/kg in a rectangular open channel, calculate the maximum discharge that may be conveyed if the channel is 5 m wide. **(3½)**

UNIT-II

Q4 (a) Derive the differential equation governing gradually varied flow, and hence define backwater and drawdown curves giving one example of each. **(3+3=6)**

(b) Using the equation derived in (a) above, show that the slopes of all surface profiles in zone 1 and zone 3 are positives indicating rising curves, and those in zone 2 are negative indicating falling curves. **(3½)**

(c) A rectangular channel 3.0 m wide has a longitudinal slope of 150 mm/km and Manning's coefficient 0.02. When the discharge in the channel is 0.85 m^3s^{-1}, determine the slope of the water surface in the channel relative to the horizontal, i.e. $(dy/dx - So)$ at a location where the depth of flow is 0.75 m. **(3)**

Q5 (a) Derive an expression for estimating the loss of energy in a hydraulic jump. What are the five classifications of hydraulic jumps based on the Froude No. of the supercritical flow? **(3+3=6)**

(b) A rectangular channel carrying supercritical flow is provided with a hydraulic jump type energy dissipater. If it is desired to dissipate 5 m head of water in the formation of the jump and if the inlet Froude number is 8.5, Find the sequent depths. **(3)**

(c) A rectangular channel carries a discharge of 2 m^3s^{-1} per metre width. if the loss of energy in the hydraulic jump is 2.75 m, show that the conjugate depths before and after the jump would be 0.214 m and 1.849 m respectively. **(3½)**

UNIT III

Q6 (a) Define a regime channel. Describe the design procedure for determining dimensions of a regime channel by Lacey's Theory. **(2.5+4=6.5)**

(b) Design a regime channel by Lacey's theory to be constructed in an alluvial soil of median size 0.6 mm. The side slopes of the channel may be adopted as ½ Horizontal: 1 Vertical. **(6)**

Q7 (a) Define 'entrainment function' according to Shield's tractive force approach for the initiation of sediment motion in a mobile boundary channel. **(2)**

(b) Draw typical sections of a lined canal, one in embankment and one in excavation following the provisions as indicated in Indian Standard Code IS: 10430-2000. **(2+2=4)**

(c) What are the advantages of lining an irrigation canal? Design a concrete lined canal to carry a discharge of 350 m^3s^{-1} at a longitudinal slope of 1 in 5,000. The side slope of the canal may be adopted as 1½:1. The value of manning's roughness coefficient for lining is 0.014. Assume a limiting velocity in the canal as 2 ms^{-1}. **(6.5)**

UNIT-IV

Q8 (a) What are diffusion, dispersion, convection and advection in the context of pollutant transport in open channel? Use sketches to explain. **(4)**

(b) What are Fick's first and second laws of molecular diffusion? **(2½)**

(c) Describe the steps in the finite volume method of solution of one-dimensional steady state diffusion equation. **(6)**

Q9 (a) Write down the one-dimensional equations of the advection diffusion, turbulent diffusion and longitudinal dispersion of the pollutant transport process in open channel describing the terms used in each equation. **(2+2+2)**

(b) The effluent from an industrial plant in a town is discharged along the centre line of a slowly meandering channel. The width of the channel is 50 m and the depth of flow is 1.0 m. The longitudinal slope of the channel is $2x10^{-4}$ and the value of Manning's roughness coefficient is 0.02. Find the length of the channel in which complete mixing over the cross section will be expected. Use the expression for the distance for complete mixing as given by Fischer et al. for longitudinal dispersion. **(6.5)**

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